HEALTHCARE FINANCIAL HARDSHIP AND HABITUAL SLEEP DURATION, IMPACT ON SLEEP DISPARITIES, AND IMPACT ON THE SLEEP-OBESITY RELATIONSHIP

By

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A Thesis Submitted to The Honors College

In Partial Fulfillment of the Bachelors degree
With Honors in

Neuroscience and Cognitive Science

THE UNIVERSITY OF ARIZONA

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Abstract

Introduction: Sleep is related to socioeconomics and can impact health. This study evaluated whether foregoing medical care due to cost impacts sleep and plays a role in sleep disparities and the sleep-obesity relationship.

Methods: Data were obtained from the 2017 Behavioral Risk Factor Surveillance System (N=39,267 from 7 states provided complete data on all variables). Sleep duration was assessed as hours/day. Participants were asked, "Was there a time in the past 12 months when you needed to see a doctor but could not because of cost?" They were also asked for information about age, sex, race/ethnicity, education, income, employment, overall health, and access to health insurance. They were also asked for height/weight, which was used to compute body mass index (BMI).

Results: Access to health insurance was not associated with habitual sleep duration. However, foregoing medical care was associated with less sleep on average (B=-0.26,95%CI[-0.35,-0.17],$p<0.0005$). There was an interaction with race/ethnicity, such that compared to non-Hispanic Whites, the effect was 115% larger among Blacks/African-Americans, 13% larger in Hispanics/Latinos, 101% larger and in the opposite direction for Asians, and non-significant for Multiracial. Race/ethnicity relationships to sleep duration were stratified by foregoing care. Among those who did not (90%), typical relationships were seen, with both high and low sleep duration being more likely among Blacks/African-Americans and other minority groups. Among those who did forego care (10%), these effects were dramatically reduced. Further, when sleep duration was evaluated as a predictor of obesity, this relationship was only seen among those who did not forego care.

Conclusion: Foregoing medical care due to cost is an independent risk factor for insufficient sleep, irrespective of income, employment, and access to insurance. It disproportionately affects Blacks/African-Americans and may represent part of the reason why these disparities exist even after adjustment for most socioeconomic indices. Further, foregoing medical care may present such health risks that this subsumes the relationship between sleep and obesity.

Introduction

Sleep is related to socioeconomics and can impact health and contribute to poor health conditions (Anders, Breckenkamp, Blettner, Schlehofer, & Berg-Beckhoff, 2014; El-Sheikh, Keiley, Bagley, & Chen, 2014; Klumpers et al., 2015; Medic, Willie, & Hemels, 2017; Mezick et al., 2008). A previous study revealed that individuals with a lower socioeconomic status tend to report both shorter sleep duration and lower sleep quality and are more likely to face a greater possibility of sleep complaints (Grandner et al., 2010). There are a great number of potential reasons for this including, old age, health problems (Foley, Ancoli-Isreal, Britz, & Walsh, 2003), and environmental noise levels (Halperin, 2014). Socioeconomic factors also influence sleep quality through other factors, such as educational level and income level of the household. More specifically, those with a higher income correlate with better sleep quality in that higher education results in higher income. Higher income contributes to better sleep quality as higher education allows an individual to have more access to higher paying job opportunities as opposed to those with a lower education level (Moore, Adler, Williams, & Jackson, 2002). Lower socioeconomic status also correlates with longer sleep latency and greater time spent being awake after sleep onset (Mezik et al., 2008). Socioeconomics impact individuals in a way that may leave a strong impact on their sleep quality and can strengthen individuals' health.

In addition, race/ethnicity may play a contributing role in sleep disparities. For instance, a previous study revealed that African Americans and Hispanic/Latino groups experience poorer sleep quality than the non-poor, White group of participants (Patel, Grandner, Xie, Branas, & Gooneratne, 2010). Another study reported that among the minority group, self-reported chronic insomnia was more common than among the Whites (Bixler, Vgontzas, Lin, Vela-Bueno, & Kales, 2002). These differences in experiences among the different race/ethnic groups suggest

that minority groups are more vulnerable to poor health and poor sleep quality (Patel, Grandner, Xie, Branas, & Gooneratne, 2010). Healthcare access may be playing a role in this relationship. Availability of access to health insurance may also influence sleep quality and sleep duration. For instance, individuals who reported lack of access to private insurance reported their experience with longer sleep latency, early morning awakenings, and snorting/gasping during sleep, all of which may disrupt good quality sleep (Grandner et al., 2013). However, those who more recently received a medical checkup reported less sleep disturbance and less daytime fatigue (Grandner et al., 2012).

There are a few reasons why access to healthcare may be associated with sleep attainment and may play a role in health, over and above its role as a general socioeconomic indicator. Perhaps decreased healthcare access is a result of poor decision making that can result from sleep loss (Harrison & Horne, 1999), inability to schedule appointments if an individual is unable to attend visits during regular hours (Cowling, Harris, & Majeed, 2016), increased debility associated with poor sleep (Lee et al., 2014), depression symptoms associated with poor sleep (Franzen & Buysse, 2018; Nutt, Wilson, & Paterson, 2008), or simply a consequence of high stress that is associated with short sleep duration (Choi, Chun, Lee, Han, & Park, 2018; Han, Kim, & Shim, 2012) or poor sleep quality (Kageyama et al., 1998). In any case, if insufficient sleep duration is associated with decreased healthcare access, this may result in decreased preventive care or care of chronic conditions, which could presumably partially explain relationships between sleep and health, in the context of more direct physiologic links (Brundisini et al., 2013). This may be particularly salient for racial/ethnic minorities, who generally experience decreased healthcare access due to loss of health insurance (Sohn, 2016).

To preliminary examine these ideas, the current study evaluated whether healthcare financial hardship is related to habitual sleep duration and whether this variable plays a role in sleep disparities and the relationship between sleep and cardiometabolic disease risk.

Methods

Data Source

The data analyzed in the present study were obtained from the 2017 Behavioral Risk Factor Surveillance System (BRFSS). BRFSS is the nation's survey system that collects data on health-related risk behaviors, chronic health conditions, and the use of preventative services regarding the residents of the United States. The sample of the study included 39,267 participants from 7 states, such as Arizona, District of Columbia, Minnesota, Nevada, North Dakota, Oregon, and Tennessee, that provided complete data on all variables.

Measures

Sleep duration was assessed as hours/day, using the item, "On average, how many hours of sleep do you get in a 24-hour period?" Responses were recorded in whole numbers and categorized as short (6 or less hours), normal (7-8 hours), or long sleep duration (9 or more hours). Participants indicated their status of access to health insurance through answering the question, "Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, government plans such as Medicare, or Indian Health Service?" Responses included "Yes," "No," "Don't know/Not sure," and "Refused." Medical financial hardship was assessed with the question, "Was there a time in the past 12 months when you needed to see a

doctor but could not because of cost?" Responses were coded as "Yes," "No," "Don't know/Not sure," and "Refused."

Those surveyed identified themselves as either Non-Hispanic White, Black/African-American, Hispanic/Latino, Asian/Pacific Islander, or Other/Multicultural. Sex was self-reported as "Male," "Female," or "Refused." Age was self-reported in years. Education level was self-reported through answering, "What is the highest grade or year of school you completed?" with the options of, "College graduate," "Some college or technical school," "High school graduate," or less than high school that were categorized as "Some high school," "Elementary," and "Never attended. School or only kindergarten." Income was determined by asking subjects, "Is your annual household income from all sources" is either "Less than $10,000," "$10,000 to less than $15,000," "$15,000 to less than $20,000," "$20,000 to less than $25,000," "$25,000 to less than $35,000," "$35,000 to less than $50,000," "$50,000 to less than $75,000," "$75,000 or more," "Don't know/Not sure," or "Refused." Subjects were also asked, "Are you currently…?" either "Employed for wages," "Self-employed," "Out of work for 1 year or more," "Out of work for less than 1 year," "A homemaker," "A student," "Retired," "Unable to work," or "Refused" to indicate employment status. Also, using the item, "Would you say that in general your health is," overall health was recorded as "Excellent," "Very good," "Good," "Fair," "Poor," "Don't know/Not sure," or "Refused."

Cardiometabolic conditions, including obesity, hypertension, and diabetes, were measured. Participants' height and weight were recorded through self-report to compute body mass index (BMI) to determine obesity. Participant's medical history of hypertension were measured through self-report with answering the question, "Have you EVER been told by a doctor, nurse or other health professional that you have high blood pressure?" If the participant

answered “Yes,” and the respondent is female, the follow-up question, “Was this only when you were pregnant?” was asked. Responses included “Yes,” “Yes, but female told only during pregnancy,” “No,” “Told borderline high or pre-hypertensive,” “Don’t know/Not sure,” or “Refused.” Also, the participant’s medical history of diabetes was measured through self-report with the question, “(Ever told) you have diabetes?” If the participant answered “Yes,” and the respondent is female, the follow-up question, “Was this only when you were pregnant?” was asked. Responses included “Yes,” “Yes, but female told only during pregnancy,” “No,” “No, pre-diabetes or borderline diabetes,” “Don’t know/Not sure,” or “Refused.”

Statistical Analysis

All variables were summarized as means/standard deviations for continuous variables and percents for categorical variables. Then, t-tests for continuous variables and chi-square tests for categorical variables examined univariate differences by medical financial hardship. To evaluate whether medical financial hardship was associated with sleep duration, continuous sleep duration was entered as an outcome of a linear regression model, with medical financial hardship as a predictor. Unstandardized regression coefficients (B) and 95% confidence intervals (CI) are reported across 4 models: (1) unadjusted, (2) adjusted for age and sex), (3) adjusted for age, sex, and other sociodemographic factors, and (4) fully-adjusted. Then, results of the unadjusted and fully-adjusted models were stratified by race/ethnicity in order to evaluate how the relationship between sleep duration and medical financial hardship differed across groups. Then, relationships between categorical sleep duration and binary health outcomes (obesity, hypertension, and diabetes) were examined in binary logistic regression analyses, adjusted for all covariates, with short and long sleep duration evaluated in reference to normal sleep duration. These analyses were stratified across medical financial hardship to evaluate how the relationship

differs across levels of this variable. All logistic regression analyses are presented as odds ratio (OR) and 95% CI. P values <0.05 were considered statistically significant. All analyses were performed using STATA 14.0 (STATA Corp, College Station, TX).

Results

Characteristics of the Sample

Sample characteristics are reported in Table 1. The sample of the study included 39,267 participants from 7 states. The average age of the sample was 48.6 ± 17.3. The sample included slightly more women (50.74%) than men, individuals from a range of race/ethnic groups, educational backgrounds, employment status, income levels, access to health insurance, body mass index, overall health, and an average sleep duration of 420 ± 84 minutes. Table 1 also stratified by foregoing medical care due to cost and examines group differences. The average age of the group who did not forego medical care is 49.4 ± 17.8, and the average age of the group who did forego medical care due to cost is 43.4 ± 12.8. In both groups, they included slightly more women than men, individuals from a range of race/ethnic groups, educational backgrounds, employment status, income levels, access to health insurance, body mass index, overall health, and an average sleep duration of 423 ± 83 minutes in the group that did not forego medical care and an average sleep duration of 403 ± 84 in those who did forego medical care due to cost.

Healthcare Financial Hardship and Sleep Duration

Table 2 displays the results of analyses examining the relationship between sleep duration and foregoing medical care due to cost. Four different models were ran: (1) unadjusted, (2) race/ethnicity adjusted, (3) sociodemographic adjusted, and (4) fully adjusted, which included all

variables. The differences in minutes of sleep duration was conveyed through the regression coefficient value. In the unadjusted analyses, those who had an experience where they could not receive medical care due to the cost reported approximately 19.5 minutes of fewer sleep on average. In the second model, the association was slightly attenuated to approximately 16.9 minutes of fewer sleep on average after adjustment for age and sex. In the third model, which was additionally adjusted for other sociodemographic factors, the relationship is similar at approximately 17.6 minutes. Finally, in the fully adjusted model, which included all covariates, the effect was about 15.3 minutes. Overall, the relationship was attenuated to about 15-18 minutes after adjustment for covariates.

Stratification by Race/Ethnicity

To examine whether the relationship between healthcare access and sleep was differentially experienced across race/ethnicity groups, the analysis was stratified by group. Results are displayed in Table 3. Among the Non-Hispanic Whites in the unadjusted model, they slept about 22 minutes less in the unadjusted model and 14.5 minutes less each night in adjusted model. The effect between healthcare financial hardship and habitual sleep duration is stronger in Blacks/African Americans, for whom foregoing medical care was associated with 33 and 32 minutes of fewer sleep in unadjusted and adjusted analyses, respectively. Among Hispanics/Latinos and Asians/Pacific Islanders, statistically significant results were only seen in adjusted analyses, where foregoing medical care was associated with approximately 17 minutes of fewer sleep among Hispanics/Latinos and 27 more minutes of sleep among Asians/Pacific Islanders.

Sleep Duration and Cardiometabolic Disease Risk

Table 4 looked at whether both short (≤ 6 hours) and long (≥ 9 hours) sleep are related to cardiometabolic disease outcomes, stratified by healthcare financial hardship. Among those who did not forego medical care due to cost in the past year, both short and long sleep were associated with increased obesity and diabetes risk, while only short sleep was associated with hypertension. Among those who did forego medical care due to cost, relationships were generally attenuated and only the relationships between short sleep and hypertension remained. These results suggest that people who forego medical care due to cost plays an important role in the relationship between sleep duration and cardiometabolic disease.

Discussion

The present study examined whether foregoing medical care due to cost would influence sleep duration and play a role in both sleep disparities and the sleep-obesity relationship. The main finding of this study was that healthcare financial hardship was associated with less habitual sleep, independent of other socioeconomic and sociodemographic factors. Healthcare financial hardship also contributes to the relationship between sleep duration and some cardiometabolic diseases (obesity, hypertension, and diabetes). The results are consistent with current literature because those who experience healthcare financial hardship may be more likely to be in lower socioeconomic status and experience more stress, and both of these factors link to less sleep (Han, Kim, & Shim, 2012; Sohn, 2016). However, even after controlling for stress, the relationship remains. This suggests that stress may have contributed to the relationship since stress associates with sleep (Han, Kim, & Shim, 2012).

In addition, this study found that the relationships between healthcare financial hardship and sleep was differentially experienced across race/ethnicity groups. The relationship between healthcare financial hardship and shorter sleep duration continues to persist across groups except in Asians/Pacific-Islanders, where they demonstrated an increase in sleep duration, whereas there is no statistical significance in the Other/Multiracial group. The degree of the relationship appears stronger among the Black/African-American population. This may be because Black/African-American adults may be more likely to forego medical care due to their high distrust in health care providers, which contributes to health disparities, reducing the amount of health care visits (Corbie-Smith, Thomas, & George, 2002; Halbert, Armstrong, Gandy, & Shaker, 2006; Musa, Schulz, Harris, Silverman, & Thomas, 2009). Also, sleep disturbances are more prevalent in African Americans and they are more likely to report short sleep hours in general (Krueger, & Friedman, 2009; Lauderdale et al., 2006; Whinnery, Rattanaumpawan, & Grandner, 2014). Since the Blacks/African-American population are more likely to experience the two factors of healthcare financial hardship and sleeping less, this may be why the relationship appears stronger. In addition, psychological stressors contribute to inadequate sleep in African Americans through triggering the stress response system, which activates the hypothalamic pituitary adrenal (HPA) axis, ultimately causing higher arousal and sleeplessness (Johnson et al., 2016). African-Americans experiences more frequent exposures to stressors because of their economic and social situations, hence stress is more expressed in their sleep (Sternthal, Slopen, & Williams 2011). Pre-existing factors in the population may explain why sleep disparities exist even after adjustment for most socioeconomic variables.

Furthermore, healthcare financial hardship was associated with more sleep in Asians/Pacific-Islanders, contrary to other groups, which showed less sleep among those that

reported medical financial hardship. It is possible that because Asians report the least sleep complaints (Grandner et al., 2010), there may be a different link between stressors such as medical financial hardship and sleep outcomes. Regarding impacts on sleep in these groups, a majority of Chinese individuals reported that they believe looking beautiful enhances the quality of life (Samizadeh & Wu, 2018) and sleep deprived individuals appear less attractive than those who are well rested (Axelsson et al., 2010) as it supports the moderate association between facial attractiveness and physical health (Rhodes, 2006). This suggests that among some Asian groups, sleep may be more likely to be seen as a remedy for poor health in lieu of medical visits. Overall, culture is salient to health (Williams et al., 2015) and cultures may contain a variety of values and expectations for contributions to overall health, including relationship to sleep. Another possibility is that because they are foregoing medical care, they sleep more to help cure their sickness as shorter sleep duration was associated with increased incidence of illnesses (Cohen, Doyle, Alper, Janicki-Deverts, & Turner, 2009; Prather, Janicki-Deverts, Hall, & Cohen, 2015).

Among those who do forego medical care due to cost, the relationship between short sleep and obesity and between short sleep and diabetes was attenuated, whereas the relationship between short sleep and hypotension was not attenuated. The same association appears for long sleep duration and the same cardiometabolic diseases. The relationship between sleep and obesity has been demonstrated in a previous study that indicated that obesity associate with a reduced sleep duration in which short sleep and poor sleep quality play a great role in the development of obesity and increases risk for diabetes in adults (Beccuti & Pannain, 2011). Also, short sleep is associated with a higher risk of hypertension, which is consistent with the current literature (Lusardi et al., 1999; Wang et al., 2015). Perhaps because avoided medical care increases risks for the chronic conditions on its own and causes poorer health management

(Kielb, Rhyan, & Lee, 2017), to the point that it overshadows the effects of sleep, even though it does seem to affect sleep. Increased health risks are associated with access to medical care since forgoing medical care prevents individuals to take the medication needed for their disease or disorder, which intensifies their disease and illness. Those who sleep less are at higher risk for diabetes, cardiovascular diseases, and other depression related disorder. And when they do forego medical care, they are at even higher risk of greater diseases because they are not receiving treatment to minimize the symptoms.

Limitations

One limitation of a self-report study is a potential for response bias due to the self-report nature of the assessments. Also, cross-sectional data precludes causality, lack of verification of healthcare status and health condition.

Future Studies

We found that in the group of Asians/Pacific Islanders, the average sleep duration in those who face healthcare financial hardship increases. A future study that may explore this relationship in greater details is to divide this group into individual subgroups of Asian/Pacific-Islanders, such as Pakistanis, Iraqis, Japanese, and other related subgroups, because cultural differences in each of the subgroups may have influenced the time differences in sleep in the Asian/Pacific-Islander subgroups since the term “Asian” is very heterogeneous. Also, the term “Asian” and “Pacific-Islander” cannot be used interchangeably. A future study can be done to answer the research question: Is there a certain subgroup of Asians in which the relationship presented in this study is maintained?

Conclusions

The study concluded that healthcare financial hardship is associated with decrease in sleep duration in particular populations. This association is seen in the unadjusted model, sex and age adjusted model, sociodemographic adjusted model, fully adjusted model, non-Hispanic White adjusted model, Black/Non-Hispanic adjusted model, and Hispanic/Latino adjusted model. The relationships are explained by their regression coefficients, suggesting a decrease in minutes of sleep in those who forego medical care due to cost. The relationship between cardiometabolic disease and sleep duration subsumed much of the relationship between healthcare financial hardship and sleep, suggesting an overlapping mechanism across both associations.

ACKNOWLEDGEMENTS

Special thanks to Michael Grandner.

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Table 1. Characteristics of the Sample

			Forego Medical Care Due to Cost		
Variable	**Category/Units**	**Complete Sample**	**No**	**Yes**	**p**
Age	Years	48.6 ± 17.3	49.4 ± 17.8	43.4 ± 12.8	<.0001
Sex	Female	50.74%	50.16%	54.63%	0.0009
Race/Ethnicity	Non-Hispanic White	72.96%	74.79%	60.76%	
	Black / African-American	7.61%	7.22%	10.22%	
	Hispanic / Latino	12.62%	11.38%	20.89%	
	Asian / Pacific Islander	3.31%	3.37%	2.87%	
	Other / Multiracial	3.50%	3.24%	5.27%	
Education	College Graduate	28.22%	30.11%	15.65%	<.0001
	Some College	34.53%	34.57%	34.22%	
	High School or GED	26.32%	25.81%	29.75%	
	Less Than High School	10.93%	9.51%	20.38%	
Employment	Employed	49.82%	50.19%	47.36%	<.0001
	Self-Employed	9.90%	9.60%	11.91%	
	Homemaker	5.65%	5.42%	7.20%	
	Student	4.09%	3.96%	4.96%	
	Retired	19.68%	21.47%	7.76%	
	Unemployed	4.71%	4.02%	9.26%	
	Unable to work	6.16%	5.35%	11.57%	
Income	$75,000 or more	32.60%	35.59%	12.71%	<.0001
	$50,000-$74,999	16.32%	16.87%	12.69%	
	$35,000-$49,999	14.26%	14.03%	15.84%	
	$25,000-$34,999	10.78%	10.21%	14.55%	
	$20,000-$24,999	10.03%	9.13%	16.02%	
	$15,000-$19,999	7.01%	6.35%	11.38%	
	$10,000-$14,999	4.48%	3.99%	7.78%	
	Under $10,000	4.51%	3.84%	9.02%	

Health Insurance	Yes	89.08%	92.27%	67.86%	<.0001
Body Mass Index	kg/m2	28.2 ± 6.4	28.1 ± 6.4	28.9 ± 6.3	0.0001
Overall Health	Excellent	16.97%	18.13%	9.24%	<.0001
	Very Good	34.06%	35.89%	21.88%	
	Good	31.50%	30.93%	35.32%	
	Fair	12.94%	11.27%	24.03%	
	Poor	4.53%	3.78%	9.53%	
Sleep Duration	Minutes	420 ± 84	423 ± 83	403 ± 84	<.0001

Table 2. Relationship of Foregoing Medical Care Due to Cost and Habitual Sleep Duration in Four Different Models

	B	SE	95% CI	p
Unadjusted	-19.531	2.454	(-24.342, -14.721)	<0.0005
Age + Sex Adjusted	-16.894	2.473	(-21.741, -12.047)	<0.0005
Sociodemographic Adjusted*	-17.652	2.638	(-22.824, -12.481)	<0.0005
Fully Adjusted**	-15.273	2.802	(-20.764, -9.781)	<0.0005

*Adjusted for age, sex, education, race/ethnicity, employment, income, and access to insurance

**Adjusted for age, sex, education, race/ethnicity, employment, income, access to insurance, overall health, and body mass index

Table 3. Relationship of Foregoing Medical Care Due to Cost and Habitual Sleep Duration, Stratified by Race/Ethnicity

UNADJUSTED:

Race/Ethnicity		SE	95% CI	p
Non-Hispanic White	-21.812	2.782	(-27.264, -16.360)	<0.0005
Black/African-American	-33.377	10.998	(-54.941, -11.813)	0.002
Hispanic/Latino	-9.063	5.88	(-20.593, 2.467)	0.123
Asian/Pacific-Islander	22.228	12.305	(-1.940, 46.396)	0.071
Other/Multiracial	-28.302	10.053	(-48.020, -8.583)	0.005

ADJUSTED*:

Race/Ethnicity	B	SE	95% CI	p
Non-Hispanic White	-14.417	3.141	(-20.575, -8.260)	<0.0005
Black/African-American	-31.503	12.174	(-55.375, -7.630)	0.01
Hispanic/Latino	-16.531	6.131	(-28.554, -4.508)	0.007
Asian/Pacific-Islander	26.583	12.617	(1.795, 51.371)	0.036
Other/Multiracial	-17.973	10.446	(-38.464, 2.517)	0.086

*Adjusted for age, sex, education, employment, access to insurance, overall health, and body mass index

Table 4. Sleep Duration and Cardiometabolic Disease, Stratified by Medical Financial Hardship

NO Medical Financial Hardship

Cardiometabolic Outcome	Sleep Duration	OR	SE	95% CI	p
Obesity	Short	1.145	0.05	(1.052, 1.246)	0.002
	Long	1.222	0.103	(1.037, 1.441)	0.017
Hypertension	Short	1.274	0.057	(1.166, 1.392)	<0.0005
	Long	0.927	0.067	(0.804, 1.069)	0.295
Diabetes	Short	1.158	0.072	(1.025, 1.308)	0.018
	Long	1.257	0.132	(1.023, 1.545)	0.029

YES Medical Financial Hardship

Cardiometabolic Outcome	Sleep Duration	OR	SE	95% CI	p
Obesity	Short	1.039	0.118	(0.831, 1.298)	0.737
	Long	0.764	0.163	(0.503, 1.159)	0.205
Hypertension	Short	1.383	0.167	(1.092, 1.752)	0.007
	Long	0.98	0.206	(0.650, 1.479)	0.924
Diabetes	Short	1.051	0.179	(0.753, 1.468)	0.769
	Long	0.893	0.25	(0.516, 1.545)	0.686